Metrology for Advanced Gate Dielectric Materials

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The research and development of new materials that enable future devices requires the most advanced materials characterization. This is especially true for the new dielectric materials that replace current generation Hf oxide based films used in state of the art transistors. While the goal of first generation Hf oxide based films was to deposit amorphous films, crystalline layers are now being investigated as a means of extending high dielectric constant films to future generations. In addition, there is a renewed interest in alloy layers such as $Hf_xZr_{1-x}O_2$ films. This presentation will review how a research team consisting of faculty and students from CNSE, working with researchers from TEL Technology Center America have relied on several X-Ray characterization methods at the NSLS to further understand structure-function relationships of high k films and film stacks with metal gates. Synchrotron based X-Ray Photoelectron Spectroscopy, Grazing Incidence X-Ray Diffraction, and texture analysis have proven invaluable to this research. We also project how the NSLS-II will enhance this research in the future.